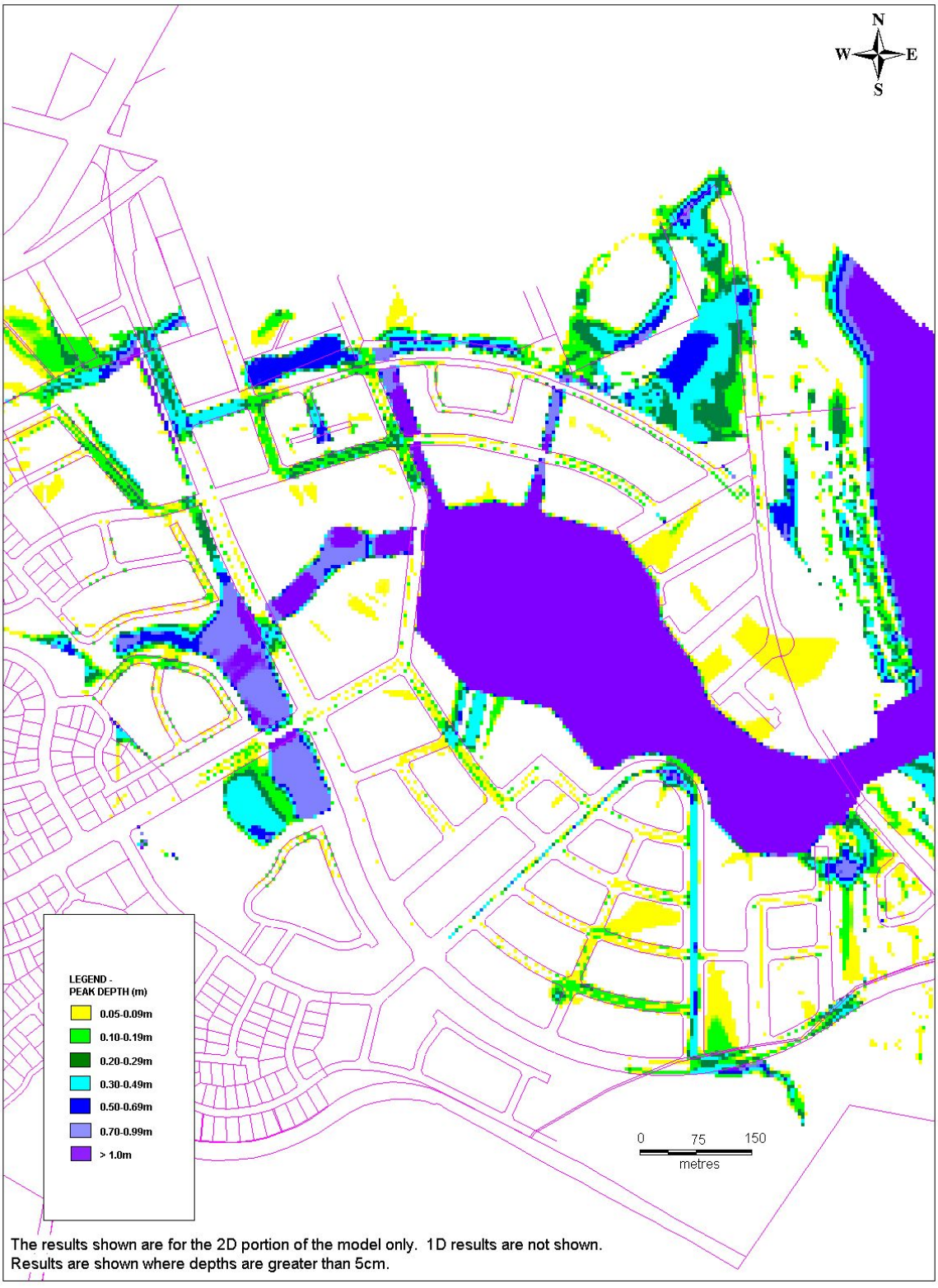

Figure 6.14 100 year ARI Peak Depth - Proposed Development

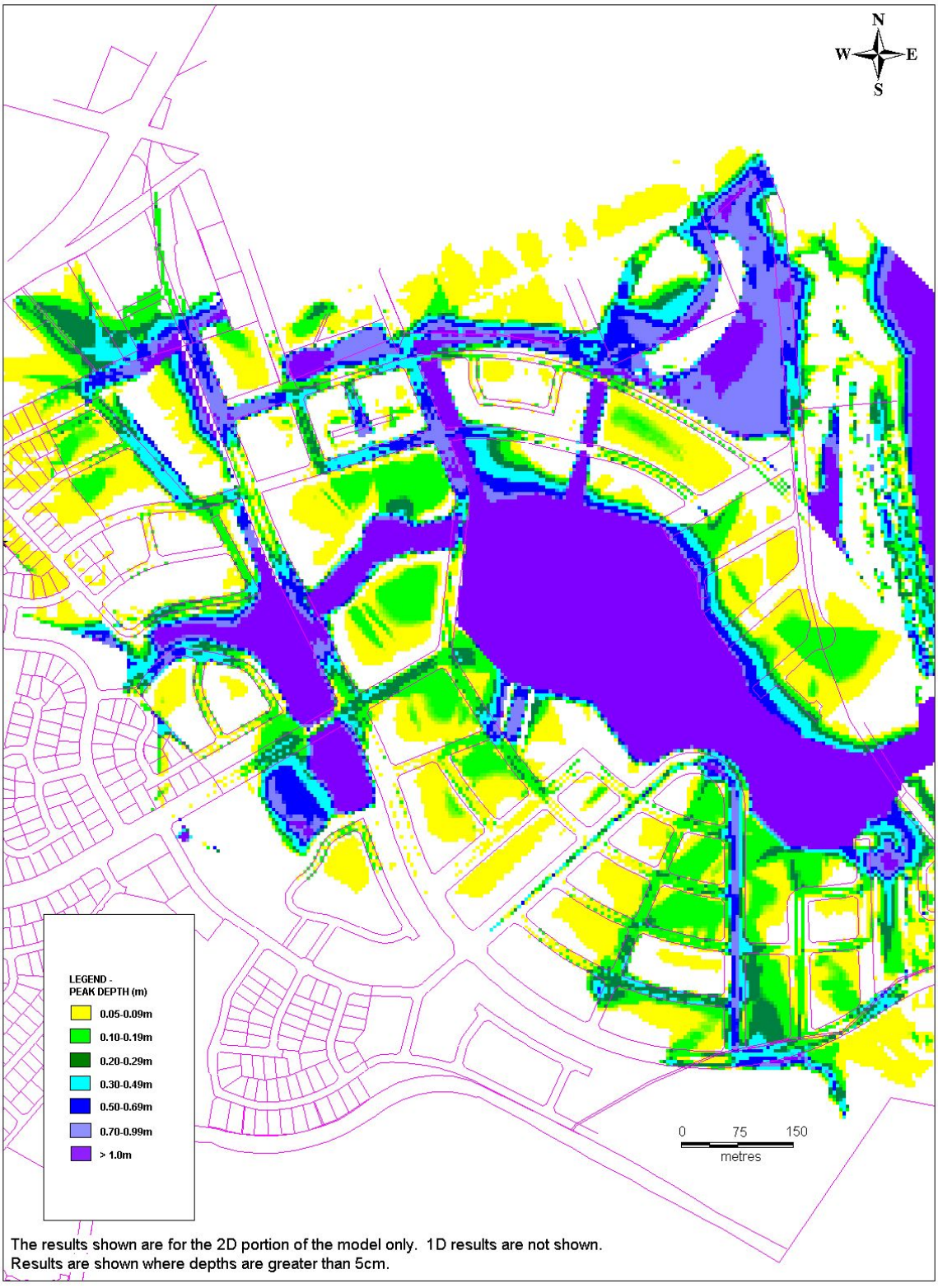

Figure 6.15 PMF Peak Depth - Proposed Development

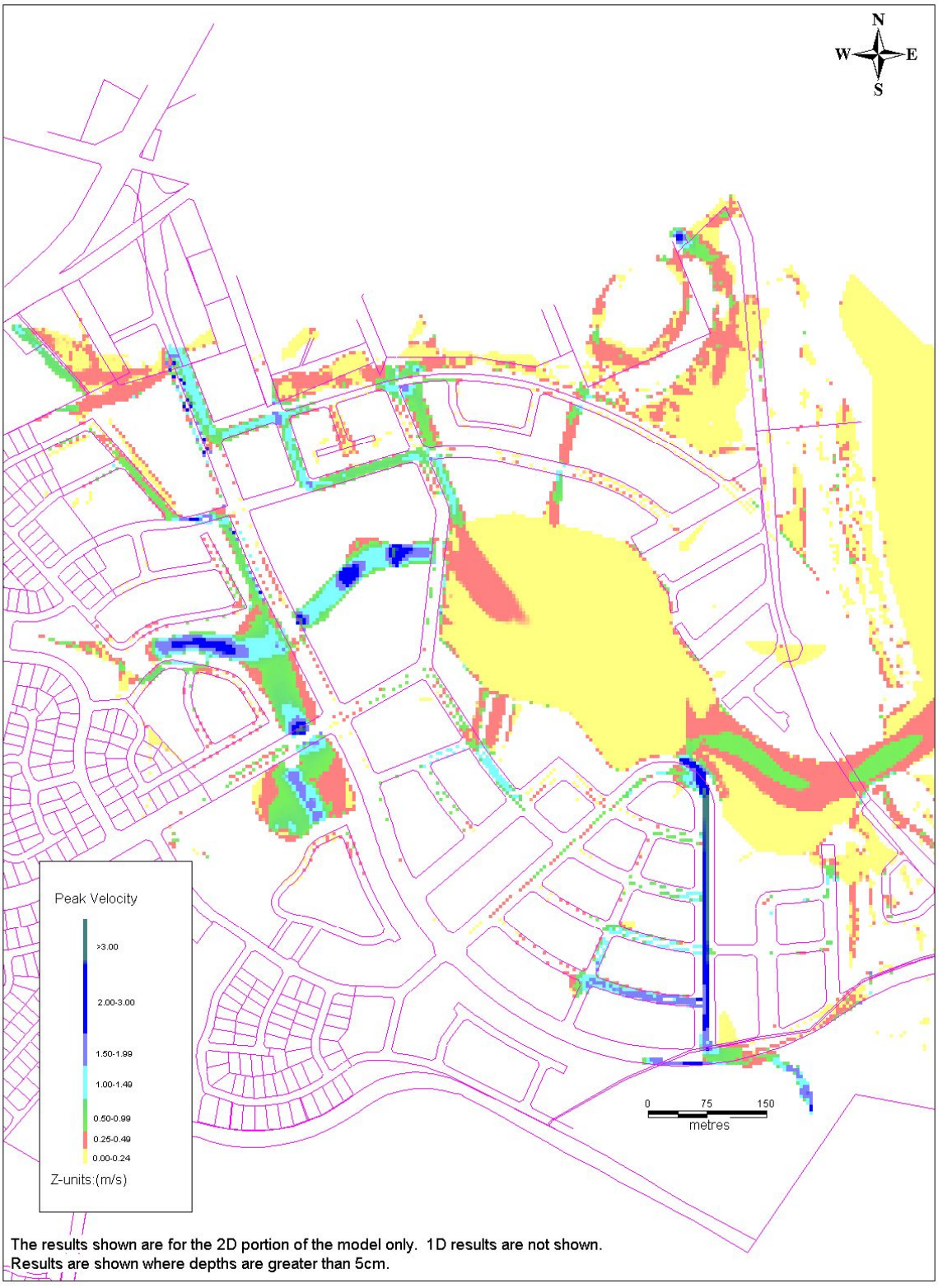

Figure 6.16 5 year ARI Peak Velocity - Proposed Development

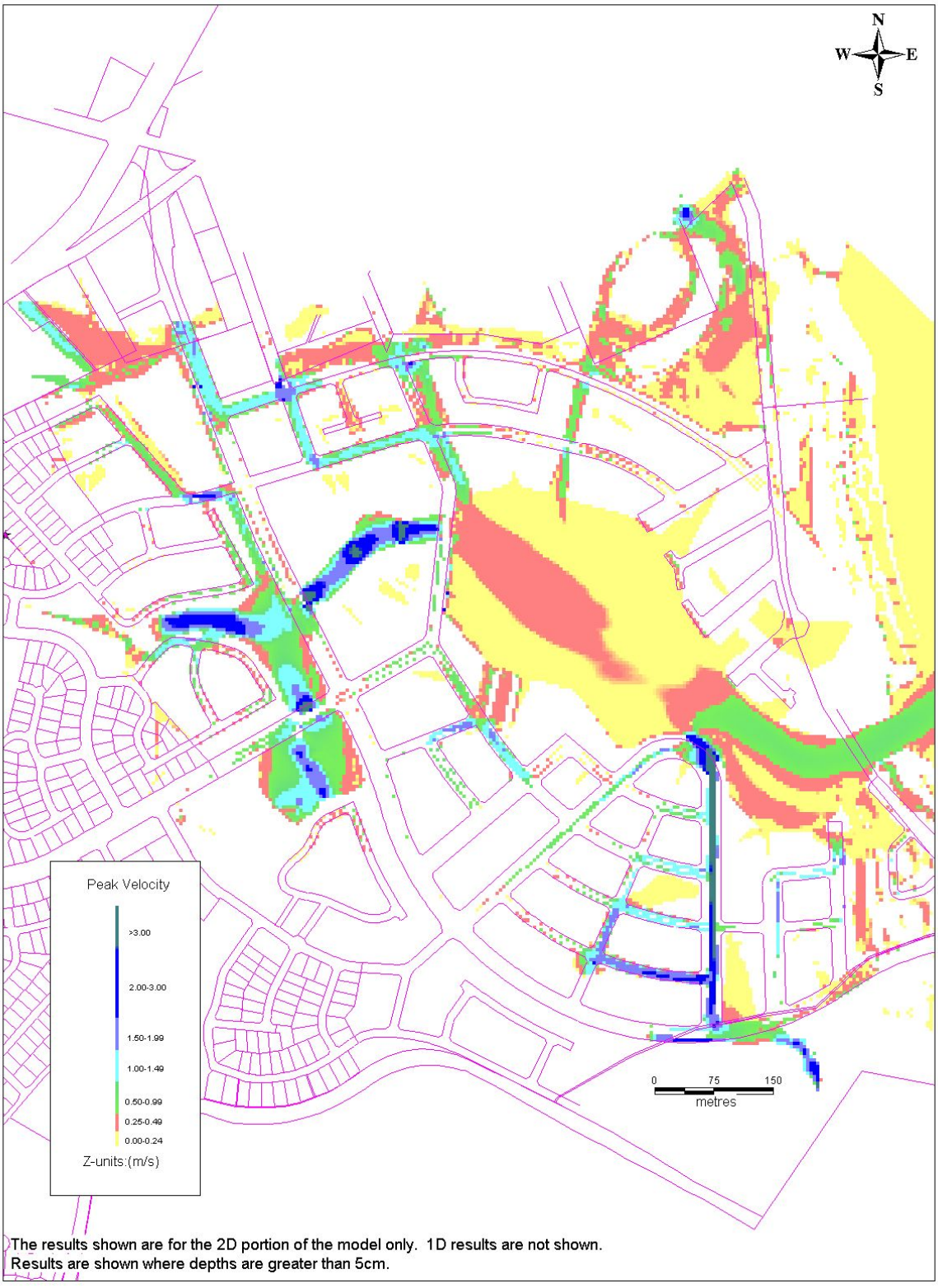

Figure 6.17 100 year ARI Peak Velocity - Proposed Development

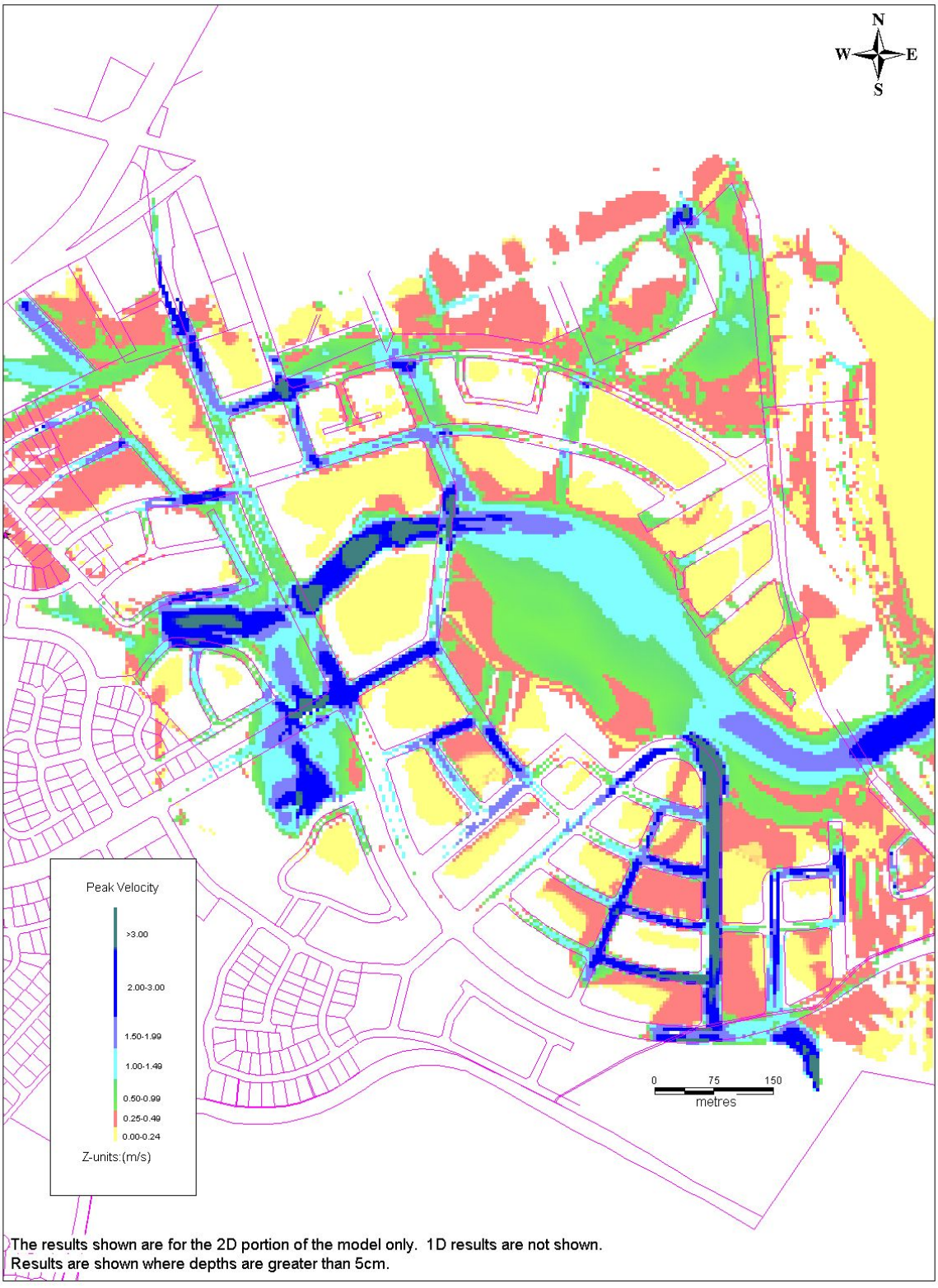

Figure 6.18 PMF Peak Velocity - Proposed Development

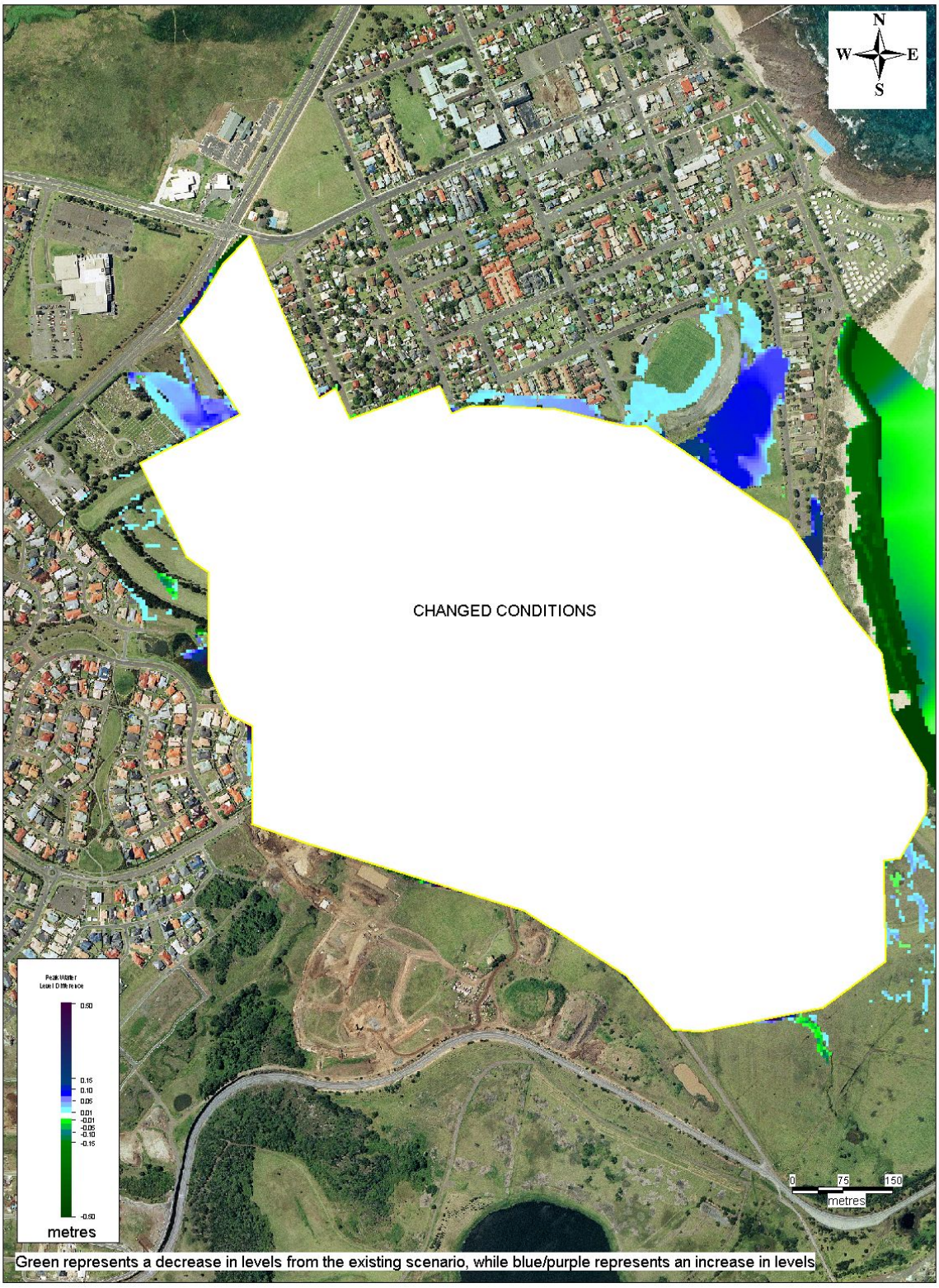

Figure 6.19 5 year ARI Impact of the Proposed Development on Existing Flood Behaviour

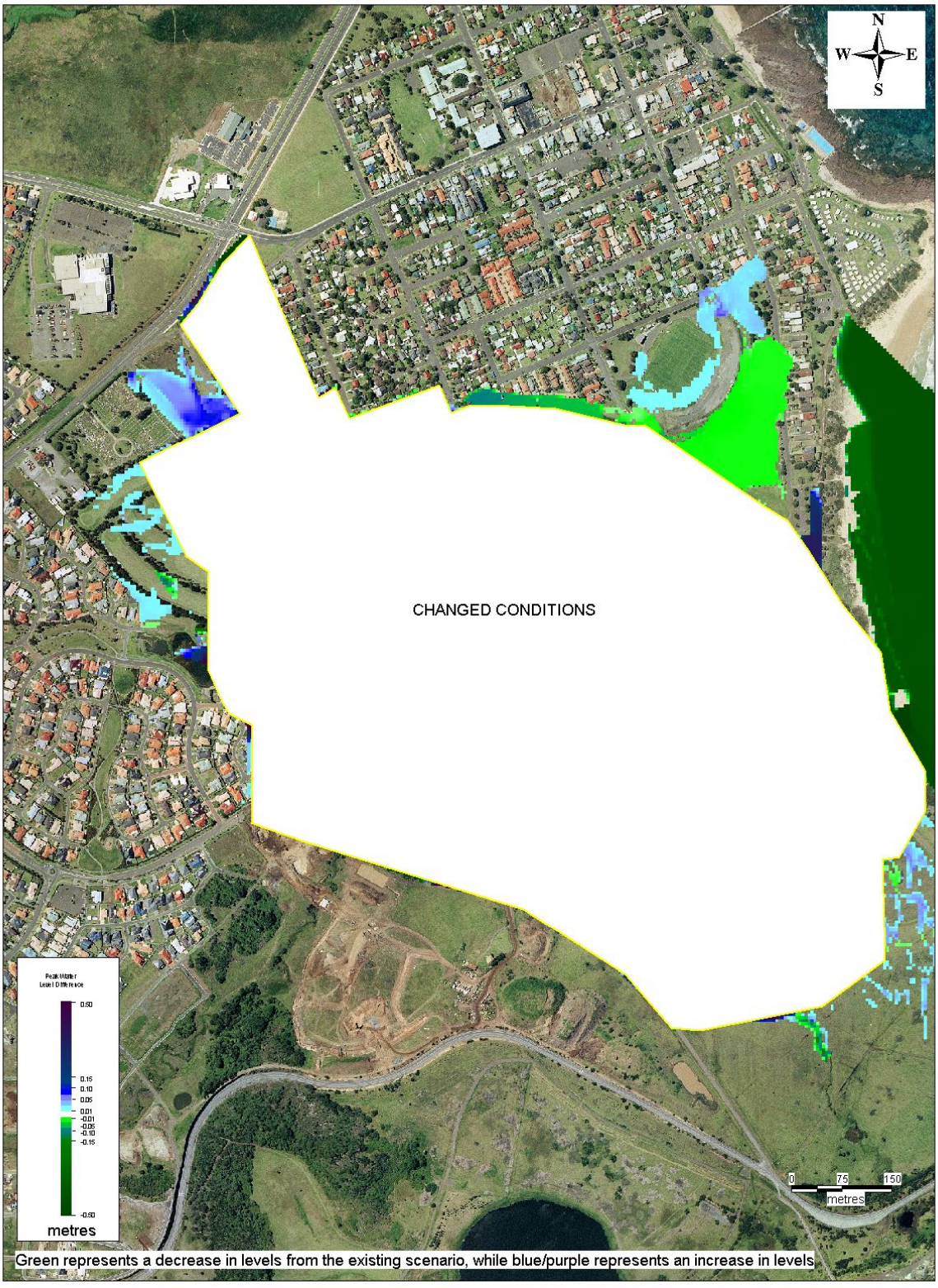

Figure 6.20 100 year ARI Impact of the Proposed Development on Existing Flood Behaviour

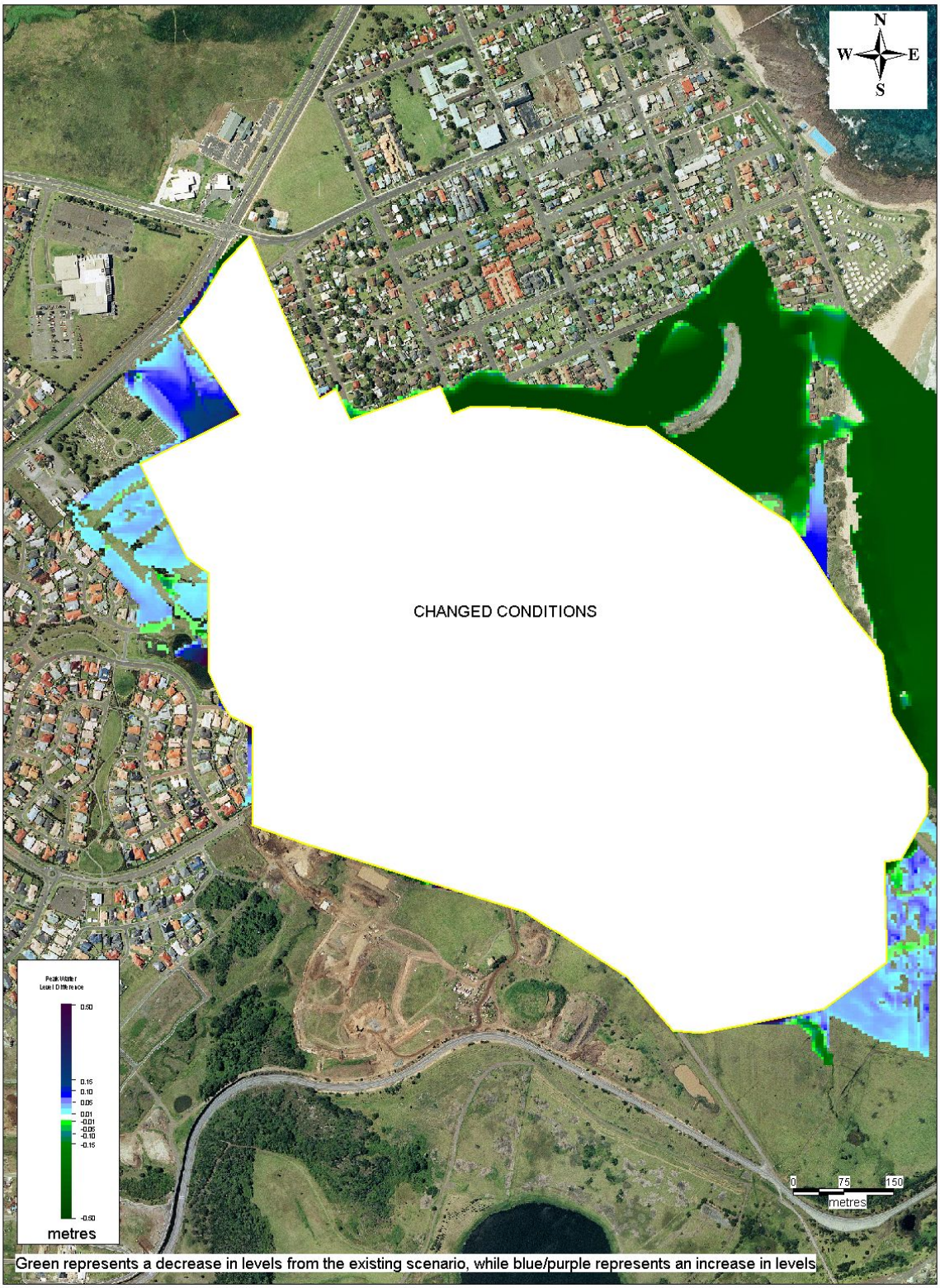

Figure 6.21 PMF Impact of the Proposed Development on Existing Flood Behaviour

7. FLOOD HAZARD AND HYDRAULIC CATEGORY MAPPING

7.1 Flood Hazard Mapping

The flood hazard mapping undertaken for this study is provisional, and only takes into account the velocity – depth relationship of hazard in accordance with Figure L2 of the Floodplain Development Manual (NSW Government, 2005). No account has been made of the other factors that form part of a True Hazard mapping assessment as described in Appendix L of the Floodplain Development Manual (NSW Government, 2005).

7.1.1 Existing Conditions

The provisional hazard for the existing scenario is shown in Figure 7.1 to Figure 7.3.

The existing hazard behaviour is described in detail in Cardno Lawson Treloar [1] (2005). The increases in downstream water level as a result of the revision in climate change estimates does not significantly impact on the hazard within the study area.

7.1.2 Design Conditions

The provisional hazard for the post development scenario is shown in Figure 7.4 to Figure 7.6.

The provisional high hazard for the post development conditions is primarily limited to the formalised overland flow paths in the area.

It is understood that it is intended to create open space areas in the northern flow paths. Based on the existing modelling, these northern flowpaths are exposed to provisional high hazard. It is not uncommon to have open space areas that are also exposed to high hazard (such as dual purpose detention basins/ ovals). It is recommended to incorporate suitable grades on the sides of these flow paths to allow for ease of evacuation should a flood event occur. Similar measures should be applied to any parkland areas in the vicinity of the proposed lakes.

Additional provisional high hazard occurs along one of the southern roads within the proposed development, which forms the main flowpath for the catchments in the south. This high hazard is generally contained within a proposed 8m wide swale down the centre of the road. As a 5m grid cell size is utilised, this swale is only coarsely defined in the model. If the swale were adequately defined, then it is likely that the high hazard would be wholly contained within the swale. It is noted that this hazard may be reduced if the stormwater pipe network were accounted for in the model. However, it would be difficult to remove this hazard completely given the grades of this road.

When compared with the existing conditions, the PMF provisional high hazard areas reduce in the Ron Costello area, part of the existing Shellharbour Village. There are no increases in provisional high hazard in the PMF, 5 year ARI or 100 year ARI design events as a result of the development.

The velocity depth multiple is provided in Figure 7.7 to Figure 7.9. The velocity times depth relationship is commonly used in the design phase of a project. In general, designs should aim for a v×d of less than 0.4.

The majority of the proposed developed experiences v×d of less than 0.4. The exception to this are the major flowpaths, which would be expected to have high v×d, and the southern road in the development. As discussed in Section 5, all pits and pipes within the proposed development have been assumed to be 100% blocked. As such, the quantity of

flow down the southern road would likely decrease, and may result in a decrease in the v×d.

7.2 Hydraulic Category Mapping

Hydraulic category mapping has been undertaken in accordance with the Floodplain Development Manual (2005). The three hydraulic categories defined for flood prone lands, floodway, flood storage and flood fringe, are described in Appendix L of the Manual.

The following methodology was adopted to identify the hydraulic categories in the model results. This methodology has been used in a number of flood studies previously.

Floodways were determined by considering those model branches that conveyed a significant portion of the total flow. These branches, if blocked or removed, would cause a significant redistribution of the flow. The criteria used to define the floodways are described below.

Floodway – As a minimum, the floodway was assumed to follow the creek line from bank to bank. Floodway has also been defined where ever the following depth and velocity criteria has been satisfied:

- Velocity * Depth must be greater than 0.25 m^2/s **and** velocity must be greater than 0.25 m/s **OR**
- Velocity is greater than 1 m/s.

Flood Storage – was defined as those areas outside the floodway, which if completely filled would cause peak flood levels to increase by 0.1 m and/or would cause peak discharge anywhere to increase by more than 10%. The flood storage has been identified as follows.

Previous analysis of flood storage in 1D cross sections assumed that if the cross sectional area is reduced such that 10% of the conveyance is lost, the criteria for flood storage would be satisfied. To determine the limits of 10% conveyance in a cross-section, the depth was determined at which 10% of the flow was conveyed. This depth, averaged over several cross-sections, was found to be 0.2 m (Howells et at, 2003). Thus the criteria used to determine the flood storage is:

- Depth greater than 0.2m
- Not classified as floodway.

Flood Fringe – All areas that were not categorised as Floodway or Flood Storage, but still fell within the flood extent are represented as Flood Fringe.

7.2.1 Existing Conditions

The hydraulic categories for the existing conditions are shown in Figure 7.10 to Figure 7.12.

These update the previous figures provided in Cardno Lawson Treloar [1] (2005). Only minor adjustments have occurred as a result of the revisions in climate change ocean levels.

7.2.2 Design Conditions

The hydraulic categories for the design conditions are shown in Figure 7.13 to Figure 7.15.

As with the provisional hazard (Section 7.1.2), the floodway areas are primarily limited to the major overland flowpaths and some of the roads in the 100 year ARI design event. As

discussed in Section 5, all pits and pipes within the proposed development have been assumed to be 100% blocked. As such, the extent of floodway areas within the roads would likely decrease.

The design does not adversely affect the classification of floodways external to the proposed development. A reduction in PMF floodway is observed in the Ron Costello Oval area and part of the existing Shellharbour Village.

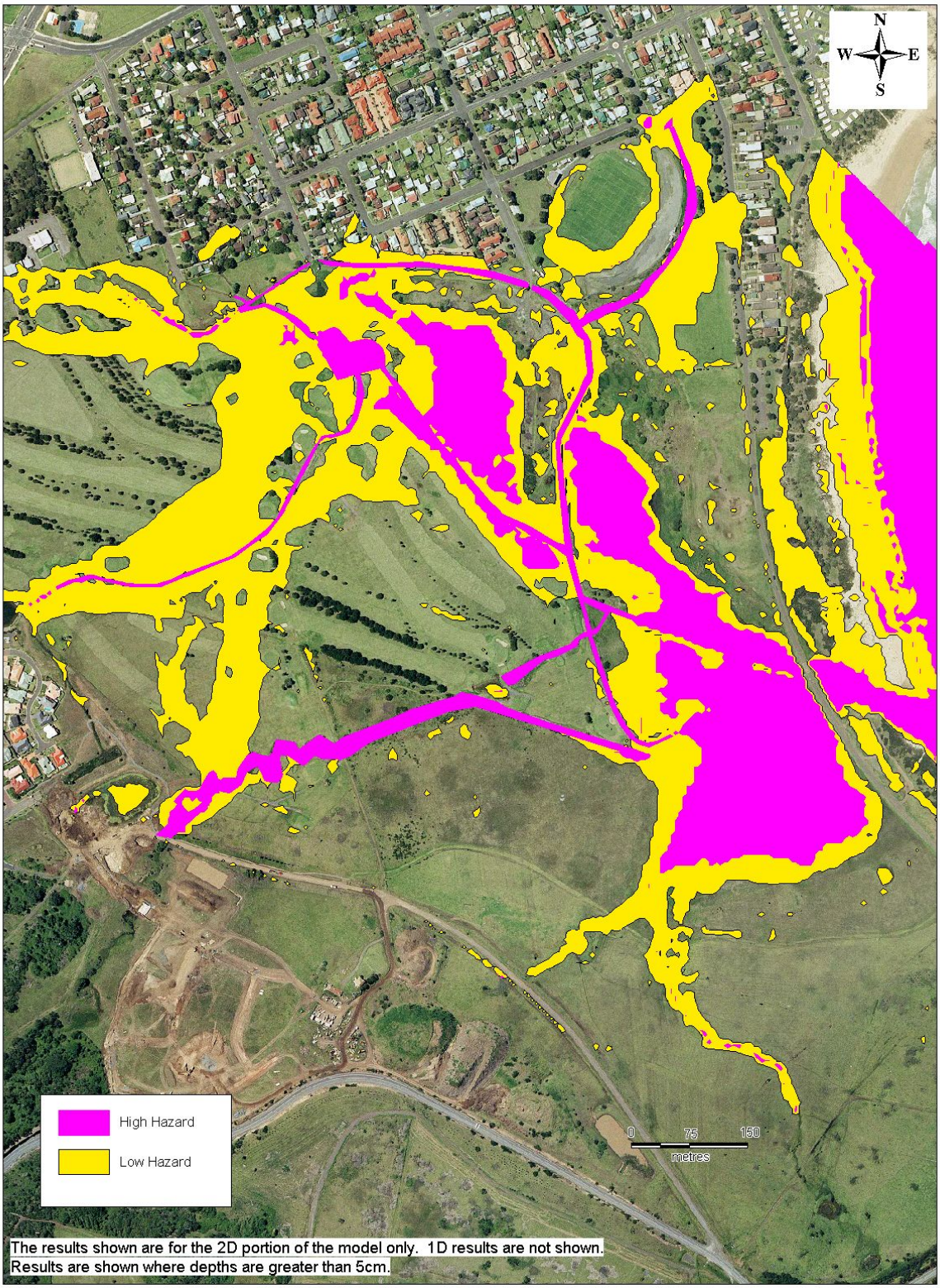

Figure 7.1 5 year ARI Provisional Hazard - Existing Scenario

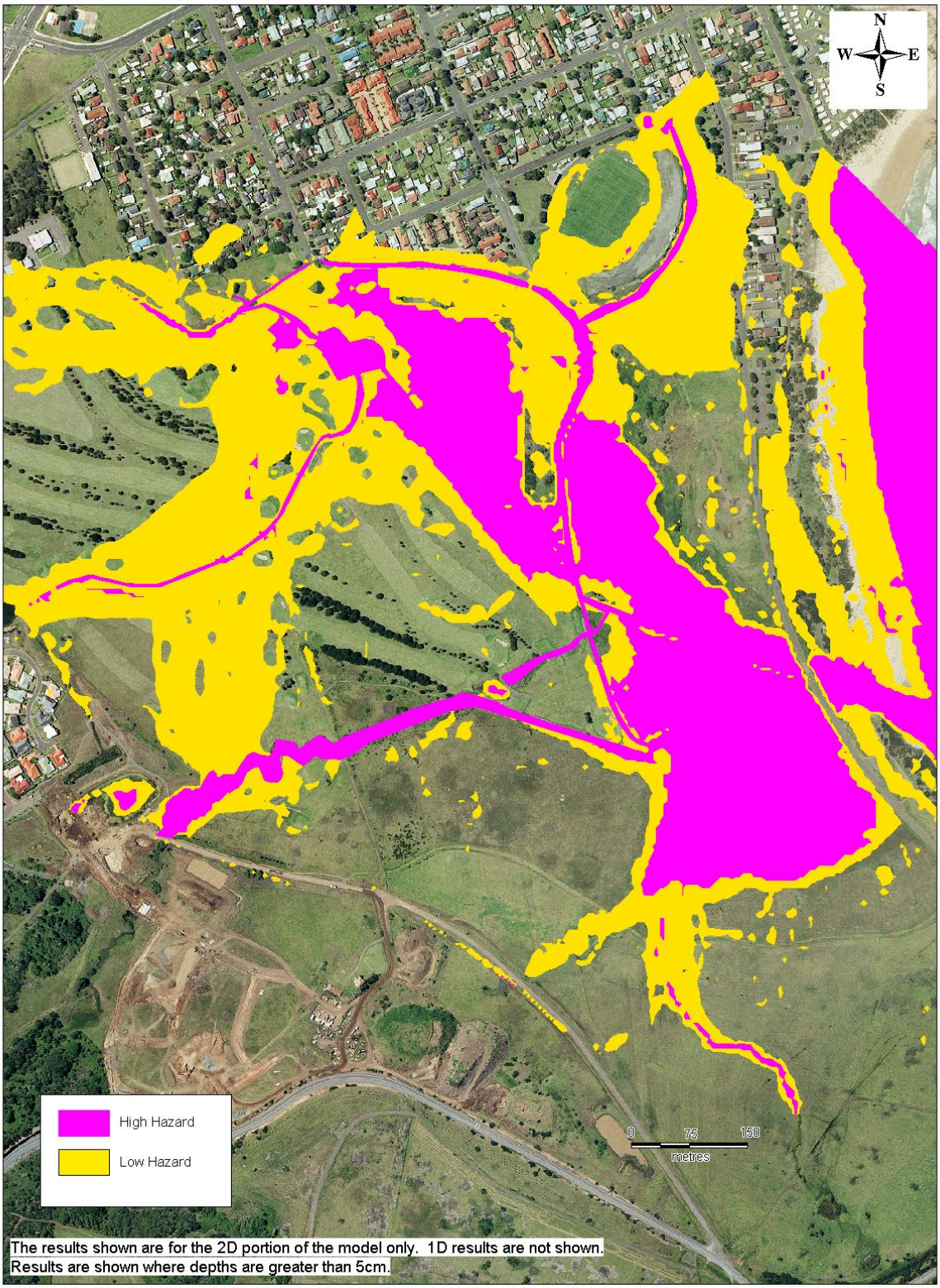

Figure 7.2 100 year ARI Provisional Hazard - Existing Scenario